

JEL Classification: L15; L86; M19

*Svitlana Pyrih, Candidate of Economic Sciences, Associate Professor**Lutsk National Technical University*<https://orcid.org/0000-0002-1205-9814>*s.pyrih@lutsk-ntu.com.ua**Пиріг Світлана, к.е.н., доцент**Луцький національний технічний університет*<https://orcid.org/0000-0002-1205-9814>*s.pyrih@lutsk-ntu.com.ua***DEVELOPMENT OF PAYMENT INFRASTRUCTURE IN CONTEXT
GROWTH OF CASHLESS SETTLEMENTS IN UKRAINE**

The article summarizes the issue of payment infrastructure development in the context of the growth of cashless payments in Ukraine, which is one of the main elements of operations, regarding the transfer of monetary value in exchange for goods/services in non-cash form. The main purpose of the study is to assess the development of the payment infrastructure and the dependence of the growth of non-cash payments on the development of the payment infrastructure. Systematization of literary sources and approaches to problem solving shows that this process requires improvement of modern technologies and new habits. The urgency of solving this scientific problem is that the development of the payment infrastructure ensures economic activity, creating conditions for the movement of funds between participants in economic circulation and provides an opportunity to effectively use financial resources that affect the stability of the financial system, the cost of operations, the liquidity of the banking system and, in general, the effective operation of the economy. Research topic development of the payment infrastructure in the context of the growth of cashless payments in Ukraine is carried out in the following logical sequence: relevance is determined; the performance indicators of the payment infrastructure in Ukraine were evaluated; the value of the correlation coefficient and the closeness of the relationship between the number of non-cash transactions and the payment infrastructure were determined. The methodological tools of the research methods were the last few years of research. The object of the research is payment infrastructure, what affects the dynamic development of non-cash payments in Ukraine. The article presents the results of the empirical analysis of the relationship growth payment infrastructure and the growth of non-cash payments. The study empirically confirms and theoretically proves that development of the payment infrastructure is a significant factor in the development potential of cashless payments in Ukraine. The results of the study can be useful for scientists and practitioners engaged in researching the development of cashless payments in Ukraine.

Keywords: *payment infrastructure, non-cash payments, payment systems, payment devices.*

**РОЗВИТОК ПЛАТІЖНОЇ ІНФРАСТРУКТУРИ В КОНТЕКСТІ
ЗРОСТАННЯ БЕЗГОТІВКОВИХ РОЗРАХУНКІВ В УКРАЇНІ**

У статті узагальнено питання розвитку платіжної інфраструктури в контексті зростання безготівкових розрахунків в Україні, що є одним із головних елементів операцій, щодо передачі грошової вартості в обмін на товар/послугу в безготівковій формі. Основною метою дослідження є оцінка розвитку платіжної інфраструктури та залежності зростання безготівкових розрахунків від розвитку платіжної інфраструктури. Систематизація літературних джерел та підходів до вирішення проблеми свідчить про те, що даний процес вимагає вдосконалення сучасних технологій та нових звичок. Актуальність вирішення даної наукової проблеми полягає в тому, що розвиток платіжної інфраструктури забезпечує економічну діяльність, створюючи умови для руху грошових коштів між учасниками економічного обігу і надає можливість ефективно використовувати фінансові ресурси, що впливають на стабільність фінансової системи, вартість операцій, ліквідність банківської системи та загалом на ефективну діяльність економіки. Дослідження теми розвитку платіжної інфраструктури в контексті зростання безготівкових розрахунків в Україні здійснюється в такій логічній послідовності: визначено актуальність; здійснено оцінку показників діяльності платіжної інфраструктури в Україні; визначено величину коефіцієнта кореляції та тісноту зв'язку між кількістю безготівкових операцій та платіжною інфраструктурою. Методологічним інструментарієм методів дослідження були кілька останніх років досліджень. Об'єктом дослідження є платіжна інфраструктура, що впливає на динамічний розвиток безготівкових розрахунків в Україні. У статті представлені результати емпіричного аналізу взаємозв'язку зростання платіжної інфраструктури і зростання безготівкових розрахунків. Дослідження емпірично підтверджує та теоретично доводить, що

розвиток платіжної інфраструктури є вагомим чинником щодо потенціалу розвитку безготівкових розрахунків в Україні. Результати дослідження можуть бути корисними для науковців та практиків, що займаються дослідженням розвитку безготівкових розрахунків в Україні.

Ключові слова: платіжна інфраструктура, безготівкові розрахунки, платіжні системи, платіжні пристрої.

Problem setting and its relationship with important scientific and practical tasks.

Payment infrastructure is one of the main elements of operations related to the transfer of monetary value in exchange for goods/services in non-cash form, which ensures economic activity, creating conditions for the movement of funds between participants in economic circulation and provides an opportunity to effectively use financial resources that affect the stability of the financial system, the cost of operations, the liquidity of the banking system and, in general, on the efficient operation of the economy.

Recent research and publications analysis. The study of issues related to the development of non-cash payments in Ukraine were engaged in by such domestic scientists as: Dykiy V. (*Dykiy, 2017*), Dzyublyuk O.V., Korneev V.V., Mishchenko V.I. (*Dzyublyuk, Korneev, Mishchenko, 2017*), Ishchuk L.I. (*Ishchuk, 2021*), Nikolayeva A.M. (*Nikolayeva, 2019*), Chupryna L.V. (*Chupryna, 2019*), and other. However, there are a number of unresolved issues regarding the role of the payment infrastructure of cashless payments, which requires further research and analysis.

The purpose of the article. The purpose the article is a study of the development of the payment infrastructure in the context of the growth of non-cash payments in Ukraine.

The main results and their rationale. According to the data of the National Bank of Ukraine, we can talk about the growth of non-cash payments thanks to the spread of the payment infrastructure. «As of January 1, 2023 – 54 payment systems were registered in Ukraine, of which: two state payment systems; 36 were created by residents (15 by banks, 21 by non-banking institutions); 16 were created by non-residents. Registered: 132 participants of payment systems (except SEP) and 35 technological operators of payment services» (*NBU, 2022*). The following payment systems operate in Ukraine:

- systemically important state, interbank system of electronic payments (SEP), in which 67 banks of Ukraine, the State Treasury Service of Ukraine and the National Bank participated as of January 1, 2023;
- card payment systems (Prostir, Visa, MasterCard and others);
- funds transfer systems (seven systems created by banks; eighteen systems created by non-banking institutions; four intrabank systems; eight systems created by non-residents).

Within Ukraine, during May-December 2022, the largest amount of payments and transfers (107 trillion UAH) was made in the SEP, which is 96%. Card payment systems made the largest number (5 billion units) of payments and transfers, which is 88% (Table 1).

Table 1. Performance activity of the payment infrastructure in Ukraine

Payment systems	May – December		
	2020	2021	2022
<i>Amount of payments and transfers, billion UAH</i>			
SEP NBU	30060	40263	107022
Card payment systems	2696	3439	4551
Money transfer systems	176	241	293
<i>Number of payments and transfers, million pcs.</i>			
SEP NBU	267	314	245
Card payment systems	4225	5328	5181
Money transfer systems	487	544	446

The dynamics of the funds circulation ratio, which shows the number of times the same hryvnia is used by participants of the payment system (SEP) during the year, is shown in (Fig.

1) where we can see that in 2021 it was 2.76 – almost 2.5 times less, than in 2022 (6.64). The value was the highest in November (9.21) and December (9.94), and the lowest in February – 2.98.

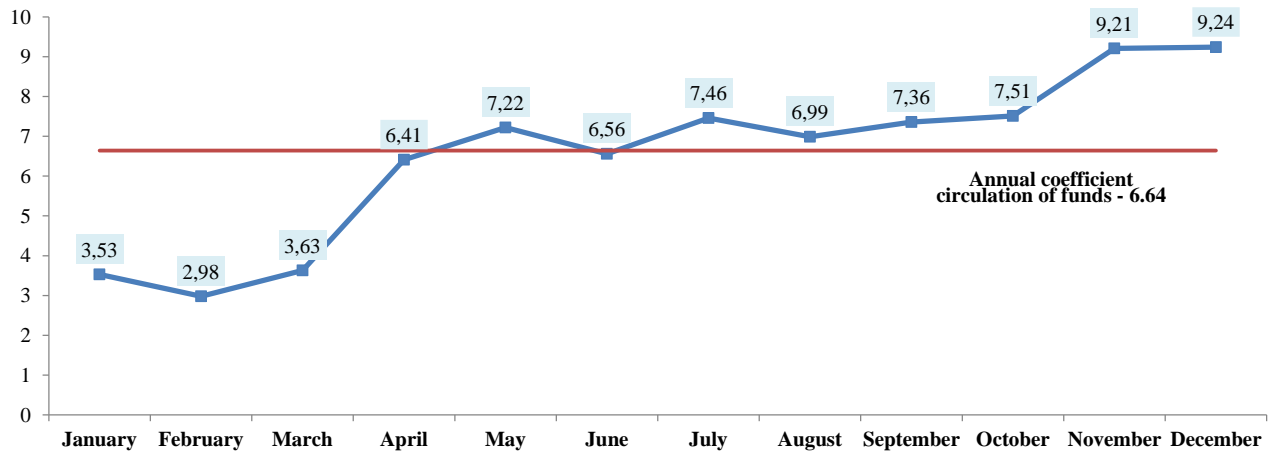


Figure 1. Dynamics of the turnover ratio of SEP funds in 2022*

*Built by the author on the basis of (НБУ, 2022)

The NBU carries out an oversight aimed at identifying and preventing the activity of the payment infrastructure that threatens the interests of users and ensuring their continuous, efficient and reliable functioning in accordance with the requirements Regulation of Oversight No. 187, where thanks specified requirements [1, 2], all participants of the payment market at the beginning of the war did not experience failures, but worked stably and reliably.

Of the 69 SEP participants, the 20 largest are singled out, in which the specific weight of payments, as of January 1, 2023, was 92,7% by number and 93,3% by amount of all payments. And by the amount of payments, the five largest participants were: the National Bank, JSC KB «PrivatBank», JSC «Raiffeisen Bank», JSC «Oschadbank», JSC «UKRSIBBANK», which made 66,5% of the amount and 63,5% of sums of all payments.

Important banks made 83,6% of the total number of payments and 39,7% of the amount of payments. General the volume of payments processed in the SEP in recent years is shown in fig. 2.

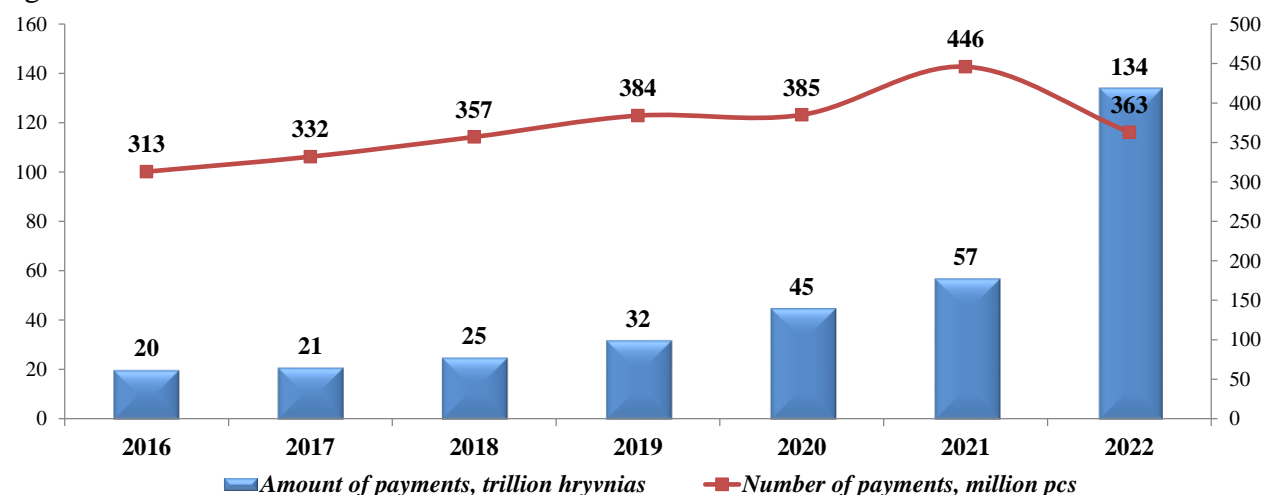


Figure 2. Dynamics of the volume of payments processed in the SEP for 2016–2022*

*Built by the author on the basis of (НБУ, 2022)

In 2021, SEP processed 446 million initial payments, which is the largest number for the entire period under investigation, and the amount of payments amounted to UAH 57 trillion,

which is UAH 12 trillion more than the amount for 2020 and UAH 77 trillion less for 2022. The number of payments is 61 million more than the previous year 2020 and 83 million more payments for 2022, which indicates an increase in amounts from UAH 100,000, that is, if in 2020 and 2021 the structure of payments from UAH 100,000 and more was 95%, then in 2022 this percentage increased by 3% and was 98%.

As of January 1, 2023, there were 67 banks operating in Ukraine, SEP clients numbered 79,4 million people (in 2021 – 72,2 million people), of which 3 million were business entities (in 2021 – 2,9 million) and 76,3 million (69,3 million in 2021) natural persons. 80% or 2,4 million economic entities and 67.7% or 51.7 million natural persons were served remotely, which is more than in 2021 by 2% of economic entities and 4% of natural persons. We can say that the growing trend of bank customers and accounts affects the growth of remote services, which in turn is reflected in the increase of non-cash payments.

The national payment system «Ukrainian Payment Space» had 54 participants at the beginning of 2023. 18 banks issue 544,000 cards of NPS «PROSTIR» payment cards, of which 298,000 pcs. or 55% active payment cards that are accepted at all merchant payment terminals in Ukraine and 15,000 pcs. ATMs, and this is 94%, which is 6% more than in 2021.

The share of non-cash transactions increased from 30% to 64% in terms of amount, and from 57% to 76% in terms of quantity. The expansion of the card acceptance network increased the volume and number of transactions and affected their constant use for payments. Figure 3 shows the volume and number of interbank transactions, where we can see a growth trend during the researched period, both in the number and volume of interbank transactions, where in 2022 the number of transactions processed by NPS «PROSTIR» amounted to 4,474 thousand items, which is 13% more than in 2021 year In 2019, the increase in quantity was 46% compared to 2018, in 2021 – by 16%. The volume of interbank transactions in 2019 compared to 2018 increased by 92%, in 2021 by 3%, in 2022 by 62.8% and amounted to UAH 3,015 million.

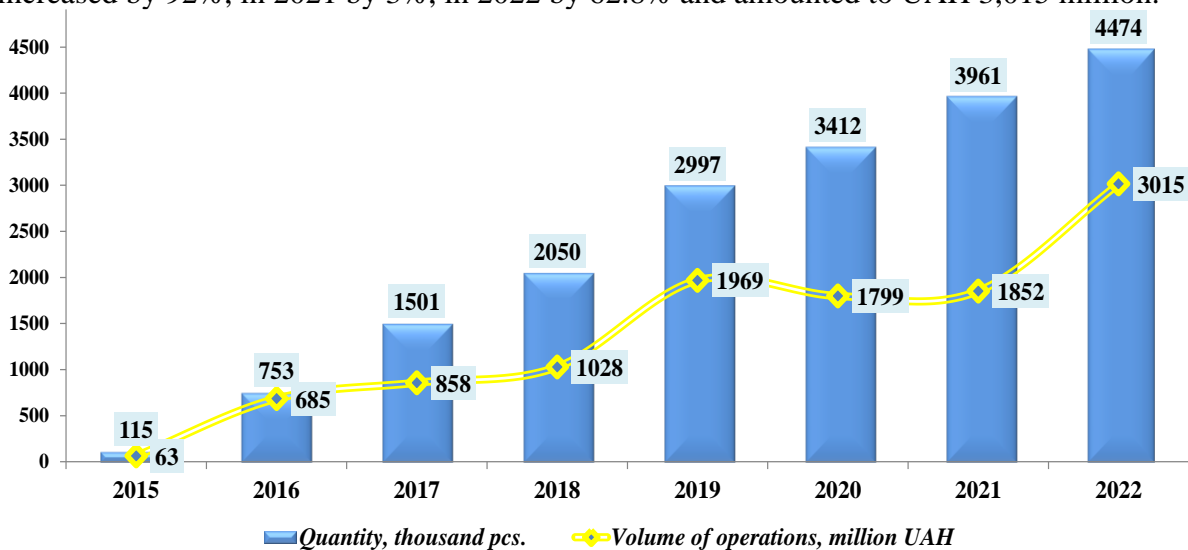


Figure 3. The volume and number of interbank transactions processed by NPS «PROSTIR»*

*Built by the author on the basis of (НБУ, NPS «PROSTIR», 2022)

The national payment system provides reliable non-cash money transfers and plays a key role in the country's economy in the implementation of a unified state monetary policy.

The dynamics of payment devices for the period 2010–2021 grew dynamically and by the end of 2021 amounted to 427,000 units. of trade POS terminals, which is 14% more than in 2020. Also, the number of business entities accepting payment cards for payment increased by 14% (372,000 units). As of January 1, 2022, the number of payment terminals is 11,000 per 1

million of the population of Ukraine, and as of January 1, 2021, 9,4 thousand units. As you can see, the level of provision of payment devices to the population of Ukraine is increasing, but compared to the provision in the European Union, it is twice as small.

In 2022, due to the war and the temporary occupation of certain territories, the number of payment devices compared to 2021 decreased by 16% – trade POS terminals, by 14% – business entities, and by 18% – bank self-service devices (Fig. 4). Also, there are banking institutions that are interested in reducing ATMs, the purpose of which is to reduce their own costs and motivate payment card users to refuse receiving cash at ATMs in the future and to use cashless payments as much as possible.

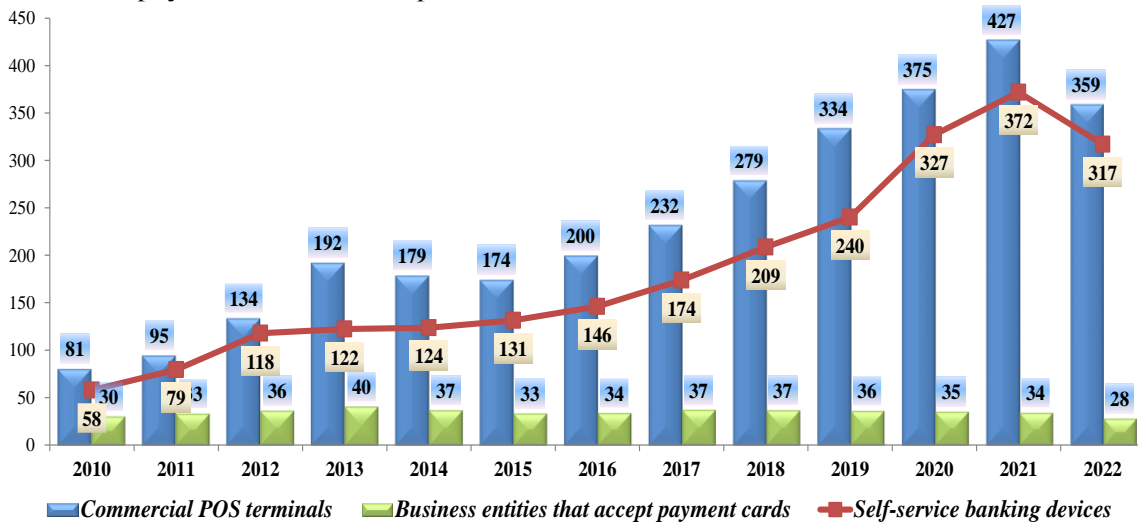


Figure 4. Dynamics of payment devices in Ukraine, thousands of units.*

*Built by the author on the basis of (НБУ, 2022)

In the Figure 5 and 6 shows data on the number of bank self-service devices, payment terminals and the number of economic entities that accept electronic payment means in Ukraine by region, where we see a tendency to reduce bank self-service devices over the years under investigation. The number of payment terminals during the years 2018-2021 had a growing trend, but the war in 2022 led to a decrease in the number of terminals in the regions of Ukraine that were most affected by the war or were temporarily occupied. The same can be said about the number of economic entities that accept electronic means of payment, where during 2018-2021 there was a positive trend of growth of devices among economic entities, and already in 2022 we see a decrease, which was heavily influenced by the war.

One of the important factors in the dynamic development of cashless payments is the growth of the payment infrastructure network and the development of modern technologies. The cooperation of NPS «PROSTIR» and the international payment system UnionPay allowed the first co-bagging payment card «PROSTIR – UnionPay International» to appear on the Ukrainian market, where the technologies of payment system data were combined, which for the national payment system became a significant expansion of the network of acceptance of its payment cards not only within Ukraine, but also in 178 countries of the world. And, since all operations are carried out on the territory of Ukraine according to the tariffs and rules of the NPS «PROSTIR», the issue of co-bagging cards for banks in Ukraine made it possible to optimize costs due to cheap service.

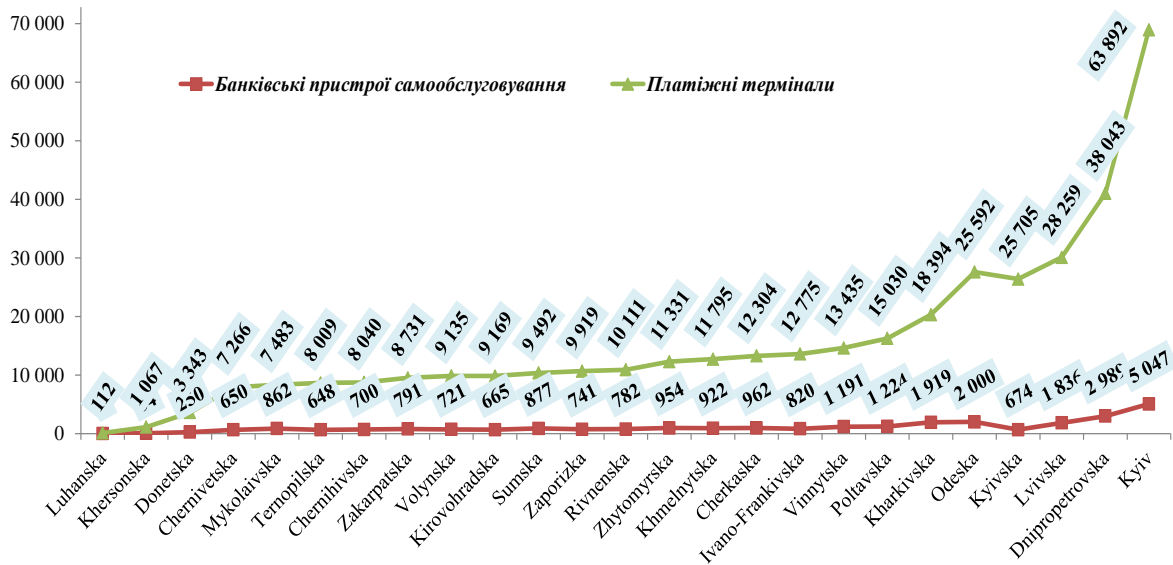


Figure 5. Dynamics of the number of self-service banking devices and payment terminals in Ukraine in terms of regions at the end 2022 eye, units

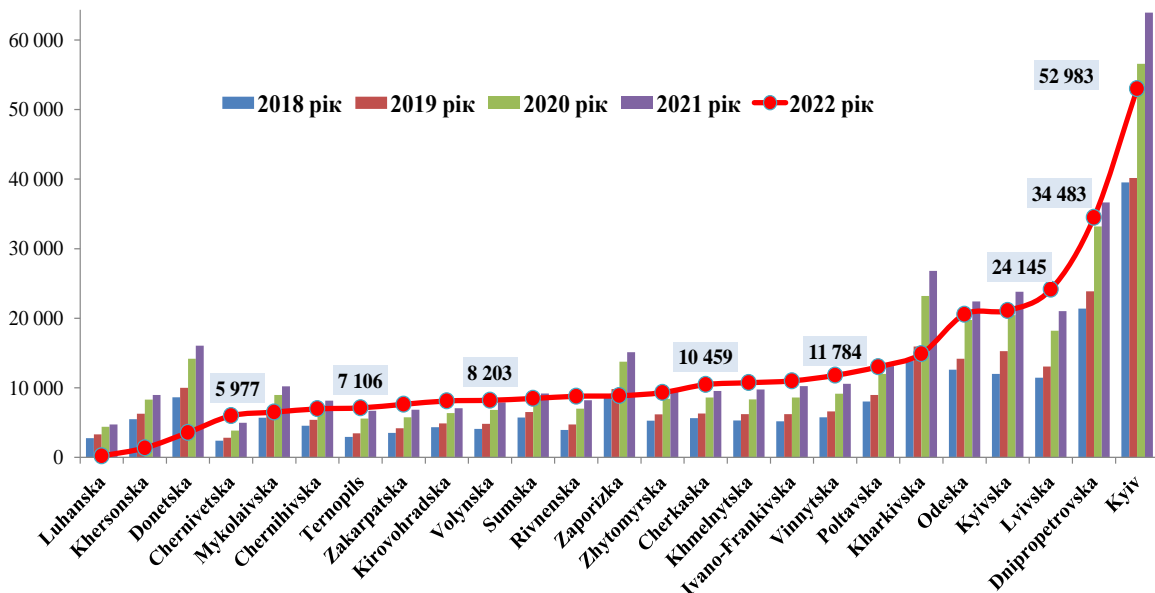


Figure 6. Dynamics of the number of business entities that accept electronic means of payment in Ukraine by region during 2018-2022

UnionPay is the leader in payment card issuance in the world (8 billion cards), and in 2020 Ukraine became the 178th country in the world when the use of a UnionPay card became available, with which you can pay for goods and services, withdraw cash from more than 2400 financial institutions around the world.

Let's check the relationship between the number of non-cash transactions and the payment infrastructure, determining the value of the correlation coefficient and the closeness of their connection. As we can see from Table 2, the correlation coefficient between the number of non-cash transactions and the payment infrastructure is equal to 0.98, which indicates a strong connection and dependence of the development of non-cash payments on the development of the payment infrastructure.

Table 2. Output data of indicators and calculation of correlation

Years	X – Number of non-cash transactions	Y – Payment Infrastructure
2017	2311	289
2018	3073	334
2019	4167	386
2020	5211	424
2021	7040	473
2022	5194	397
Connection equation:	Y =	213,2181+0,0384 X
Coefficient of elasticity:	e =	0,4404
Mean squared:	s _x =	1661,3462
deviation:	s _y =	64,8294
Correlation coefficient:	g =	0,9863
Correlation coefficient reliability criterion:	m =	72,6198

On the distribution graph, we can see that the number of non-cash transactions increases due to the growth of payment devices, while the reduction, on the contrary, decreases their number (Figure 7).

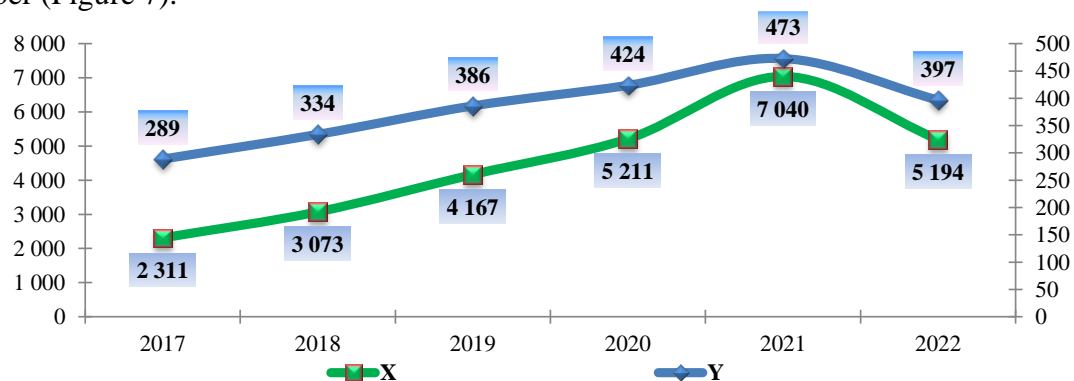


Figure 7. Distribution graph of Y (Number of non-cash transactions, million units) and X (Payment infrastructure, thousand units)

Conclusions, discussions and recommendations. Developed payment infrastructure, including fast and reliable payment systems, payment terminals, data transmission networks, contribute to the convenience and efficiency of cashless payments. The presence of advanced technologies and their availability affect the ability of consumers and businesses to carry out cashless transactions. The development of non-cash payments clearly depends on how widely non-cash payments are accepted in various areas of the economy. If the payment infrastructure provides support for non-cash payments in retail outlets, restaurants, public transport, etc., this significantly contributes to the growth of non-cash payments. Also important is the support of the payment infrastructure for international payments and transfers, which ensures the convenience and availability of cashless payments for global operations, tourism and international trade.

Author contributions

Conceptualization: Svitlana Pyrih

Data storage: Svitlana Pyrih

Formal analysis: Svitlana Pyrih
 Purchase of funding: Svitlana Pyrih
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 Confirmation: Svitlana Pyrih
 Visualization: Svitlana Pyrih
 Project administration: Svitlana Pyrih
 Writing: Svitlana Pyrih

Список бібліографічного опису:

1. НБУ. Звіт з оверсайту інфраструктури фінансового ринку (2022). URL: https://bank.gov.ua/admin_uploads/article/Report_oversight_2022.pdf?v=4 (дата звернення: 18.06.2023).
2. Положення про порядок здійснення оверсайту платіжної інфраструктури в Україні від 24.08.2022 №187. URL: <https://zakon.rada.gov.ua/laws/show/v0187500-22#Text> (дата звернення: 25.06.2023).
3. НБУ. СЕП URL: <https://bank.gov.ua/ua/payments/sep> (дата звернення: 10.06.2023).
4. НБУ. Національна платіжна система «Український платіжний простір» URL: <https://bank.gov.ua/ua/payments/prostir> (дата звернення: 15.07.2023).
5. Чуприна Л.В. (2019). Проблеми та перспективи розвитку безготівкових розрахунків в Україні. URL: http://market-infr.od.ua/journals/2019/32_2019_ukr/71.Pdf (дата звернення: 10.07.2023).
6. Дзюблюк О.В., Корнєєв В.В., Міщенко В.І. (2017). Теорія і практика грошового обігу та банківської справи в умовах глобальної фінансової нестабільності: монографія / за ред. д.е.н., проф. О.В. Дзюблюка. Тернопіль: ФОП Осадца Ю.В., 2017. 298 с.
7. Дикий В. (2017). Розвиток безготівкової економіки в Україні. URL: http://management.fmm.kpi.ua/wp-content/uploads/2017/12/Cashless-economy_05.12.2017.pdf (дата звернення: 14.07.2023).
8. Ніколаєва А.М., Пиріг С.О., Олександренко І.В. (2019). Безготівкові розрахунки: показник економічного зростання країни. Економічний форум: Наук. ж-л. Луцьк: РВВ ЛНТУ, 2019. №1. С. 151-158.
9. Ішчук Л. І., Пиріг С. О., Олександренко І. В. (2021). Оцінка рівня ринку платіжних карток та чинники впливу на його розвиток. Економічний форум. Наук. ж-л. Луцьк: РВВ ЛНТУ, 2021. №1. 168 с. С. 184-192.
10. Ішчук Л.І., Пиріг С.О., Вахновська Н.А. (2018). Роль платіжних систем в розвитку безготівкової економіки України. Зб. наук. пр. «Економічні науки». Серія «Облік і фінанси». Випуск 15 (57). Луцьк: ЛНТУ, 2018. С. 107-115.

References:

1. NBU Financial Market Infrastructure Oversight Report (2022). URL: https://bank.gov.ua/admin_uploads/article/Report_oversight_2022.pdf?v=4 (accessed 18 June 2023) [in Ukrainian].
2. Regulation on the procedure for conducting an oversight of the payment infrastructure in Ukraine dated August 24, 2022 No. 187. URL: <https://zakon.rada.gov.ua/laws/show/v0187500-22#Text> (accessed 25 June 2023) [in Ukrainian].
3. NBU. SEP URL: <https://bank.gov.ua/ua/payments/sep> (accessed 10 June 2023) [in Ukrainian].
4. NBU National payment system «Ukrainian payment space» URL: <https://bank.gov.ua/ua/payments/prostir> (accessed 15 July 2023) [in Ukrainian].
5. Chupryna L.V. (2019). Problems and prospects of the development of non-cash payments in Ukraine. URL: http://market-infr.od.ua/journals/2019/32_2019_ukr/71. (accessed 10 July 2023) [in Ukrainian].
6. Dzyublyuk O.V., Korneev V.V., Mishchenko V.I. (2017). Theory and practice of money circulation and banking in conditions of global financial instability: monograph / edited by Doctor of Economic Sciences, Prof. O.V. Dzyublyuk Ternopil: FOP Osadtsa Yu.V., 2017. 298 p.
7. Dyky V. (2017). Development of cashless economy in Ukraine. URL: http://management.fmm.kpi.ua/wp-content/uploads/2017/12/Cashless-economy_05.12.2017.pdf (access date: (accessed 14 July 2023) [in Ukrainian].
8. Nikolayeva A.M., Pyrig S.O., Oleksandrenko I.V. (2019). Non-cash payments: an indicator of the country's economic growth. Economic Forum: Science. zh-l Lutsk: RVV LNTU, 2019. No. 1. P. 151-158.
9. Ishchuk L. I., Pyrig S. O., Oleksandrenko I. V. (2021). Assessment of the level of the payment card market and factors affecting its development. Economic Forum. Science zh-l Lutsk: RVV LNTU, 2021. No. 1. 168 p. P. 184-192.
10. Ishchuk L.I., Pyrig S.O., Vakhnovska N.A. (2018). The role of payment systems in the development of the cashless economy of Ukraine. Coll. of science Ave. «Economic Sciences». «Accounting and Finance» series. Issue 15 (57). Lutsk: LNTU, 2018. P. 107-115.

Received: 12.09.2023

Accepted: 22.09.2023

Published: 20.10.2023